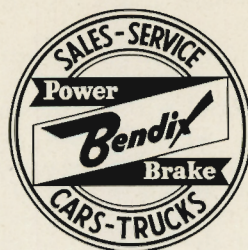


BENDIX POWER BRAKE SERVICE MANUAL



BENDIX MASTER-VACS

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BENDIX MASTER-VAC POWER BRAKE UNITS

DESCRIPTION

The Master-Vac is a self-contained vacuum and hydraulic power braking unit. It is of the atmospheric suspended type which utilizes engine intake manifold vacuum and atmospheric pressure for its power. It consists of three basic elements combined into a single unit, see Figures 1 and 3.

The three basic elements are:

- 1 A vacuum power cylinder which consists of a cylinder, a vacuum power piston, a hydraulic push-rod and vacuum piston return spring.
- 2 A mechanically actuated control valve integral with the vacuum power piston controls the degree of power brake application or release in accordance with the foot pressure applied to the valve operating rod through the brake pedal linkage. The control valve consists of a single poppet with an atmospheric port and a vacuum port. The atmospheric port seat is a part of the valve plunger which moves within the vacuum power piston. The vacuum port seat is a part of the rear piston plate.
- 3 A hydraulic cylinder which contains all of the elements of the conventional brake master cylinder except the hydraulic push-rod.

The vacuum power piston and the components which make up the valve assembly are connected to the brake pedal through the valve operating rod and pedal linkage. The valve operating rod is connected to the valve plunger which operates within the power piston. A valve return spring returns the valve plunger and rod to the released position when the brakes are released. The valve poppet is supported within the power piston by a flexible rubber diaphragm in the power piston. In the released position a poppet return spring and atmospheric pressure holds the poppet against the vacuum port seat. A boot type of seal is used to seal the opening between the piston plate and the valve operating rod. A rubber hose connects the vacuum inlet fitting on the end plate and bracket assembly with the hose fitting on the vacuum power piston. Air for operation is admitted through the air cleaner attached to the end plate and bracket. The hydraulic cylinder is attached to the end of the vacuum power cylinder and is sealed off from the vacuum cylinder by the secondary cup. A rubber seal on the hub of the hydraulic cylinder seals the vacuum cylinder against external air leaks. A hydraulic push-rod forms the link between the vacuum power piston and the hydraulic piston in the hydraulic cylinder.

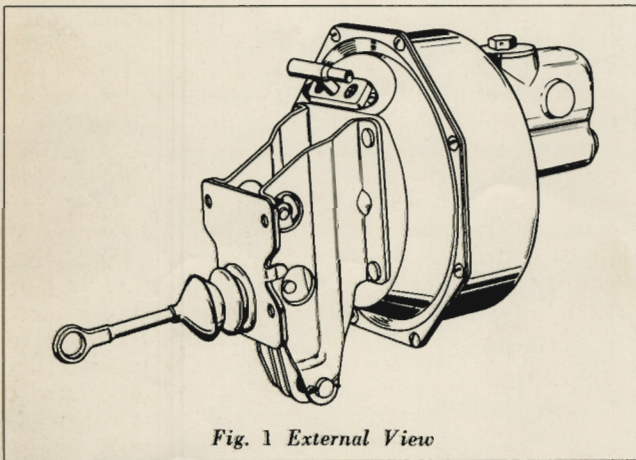


Fig. 1 External View

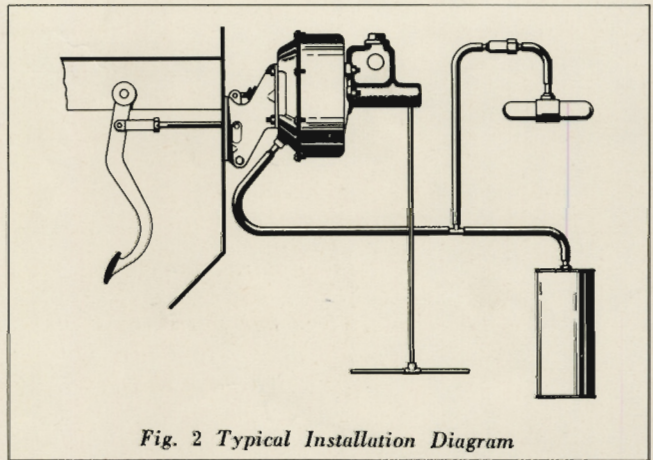


Fig. 2 Typical Installation Diagram

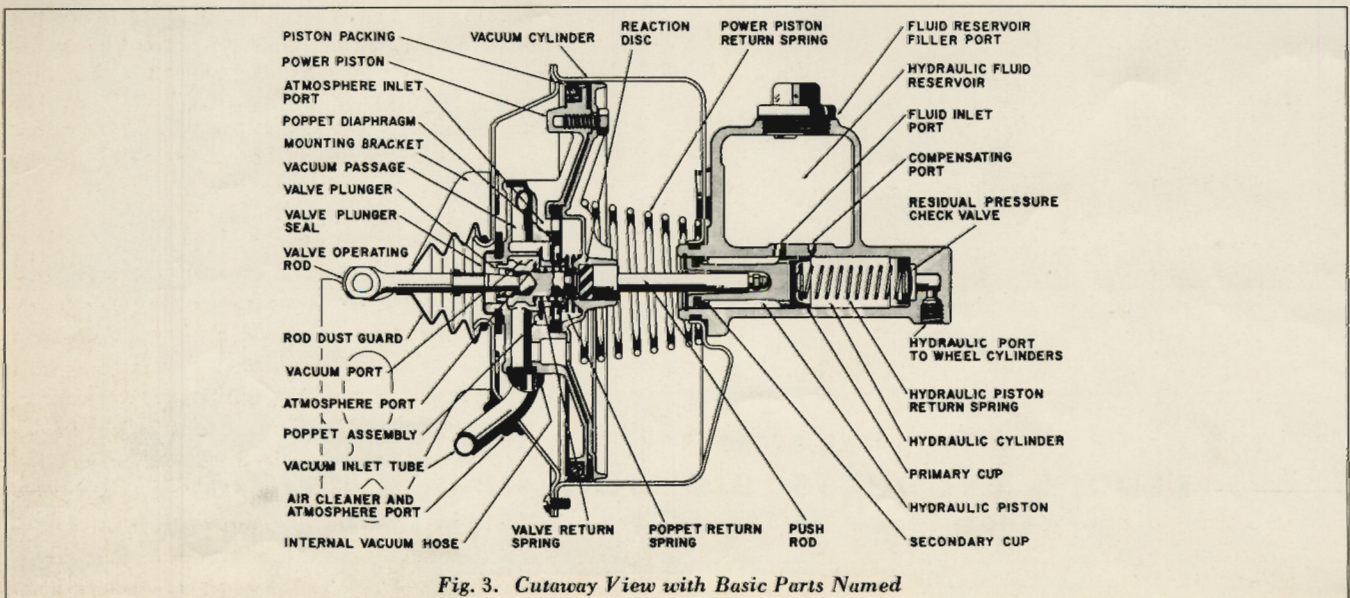


Fig. 3. Cutaway View with Basic Parts Named

PRINCIPLES OF OPERATION

Released Position, See Fig. 4

With the engine running and the brakes released, vacuum from the engine intake manifold is admitted to the Master-Vac through the vacuum tubing, check valve and reservoir to the vacuum side of the control valve. In the released position (no pressure applied to the brake pedal), the valve operation rod and plunger are held to the left in the power piston by the valve return spring to CLOSE the vacuum port and OPEN the atmospheric port. The atmosphere present in the cylinder chamber to the left of the

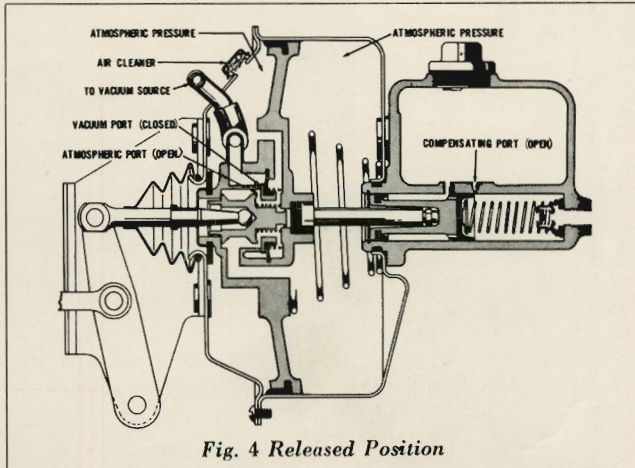


Fig. 4 Released Position

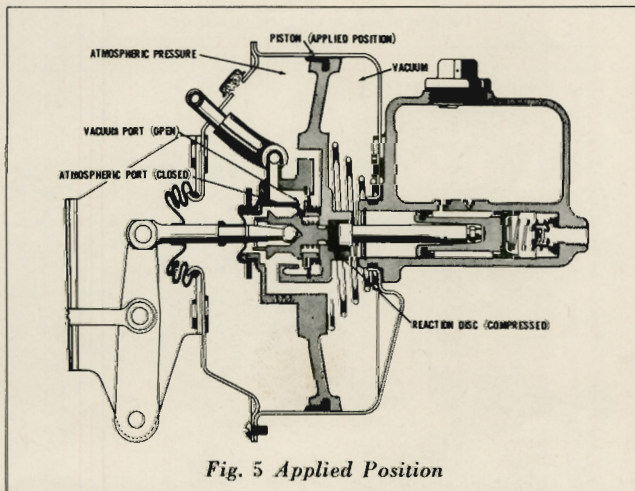


Fig. 5 Applied Position

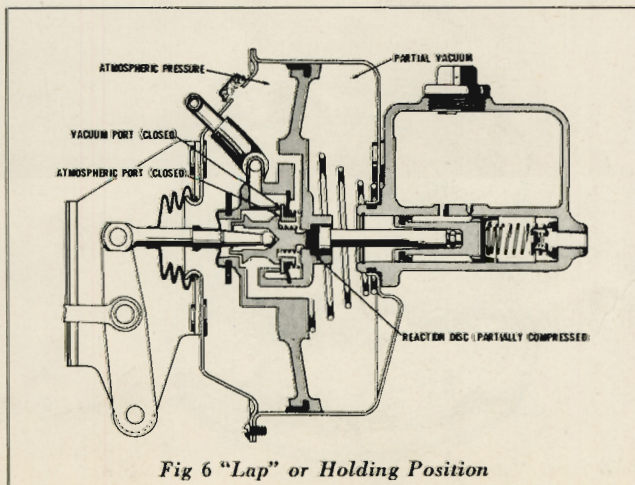


Fig. 6 "Lap" or Holding Position

power piston is then free to pass through the atmospheric port of the valve and porting in the piston to the chamber at the right of the piston. The power piston is then balanced or suspended in atmosphere since atmospheric pressure is present on both sides of the piston. With the hydraulic push-rod in the release position, the hydraulic compensating port in the hydraulic master cylinder is open to permit fluid to either return from the brake system to the fluid reservoir or enter the brake system from the fluid reservoir.

Applied Position, See Fig. 5

As the brakes are applied by the driver, the valve operating rod and valve plunger move to the right in the power piston to compress the valve return spring and bring the atmospheric valve seat in contact with the poppet valve to CLOSE the atmospheric port. Any additional movement of the valve operating rod and valve plunger in the applied direction will move the poppet away from the vacuum valve seat to open the vacuum port and establish direct communication through the power piston and valve to the cylinder chamber at the right of the power piston. With vacuum on the right side of the power piston and atmospheric pressure on the left side of the piston, a force is developed to move the power piston, hydraulic push-rod and hydraulic piston to the right to close the compensating port and force hydraulic fluid under pressure through the residual pressure check valve and brake tubes into the brake wheel cylinders. As hydraulic pressure is developed in the hydraulic cylinder, a counter force (to the left) acting through the hydraulic push-rod sets up a reaction force against the valve power piston and valve plunger through the rubber reaction disc at the end of the hydraulic plunger. The rubber disc acts similar to a column of fluid to distribute the pressure between the power piston and to the valve plunger in proportion to their respective contact areas. The pressure acting against the valve plunger and valve operating rod tends to move the valve plunger slightly to the left in relation to the piston to close off the vacuum port. Since a part of the counter force (to the left) reacts through the valve plunger and valve operating rod against the driver's foot, a "feel" of the braking effort is provided. The amount of reaction transmitted to the valve plunger is designed into the Master-Vac to assure maximum power consistent with the assurance that the driver always maintains a "feel" of the amount of brake that is being applied. This reaction force is in direct proportion to the hydraulic pressure developed within the brake system.

"Lap" or Holding, See Fig. 6

During application of the brakes the "reaction" against the valve plunger is working against the driver to close the vacuum port. With both vacuum and atmospheric ports closed, the Master-Vac is then said to be in the "lap" or holding position. With both valves closed or "lapped" off, any degree of brake application attained will be held until either the vacuum port is reopened by an increase in pedal pressure to further increase the brake application or by a decrease in pedal pressure to reopen the atmospheric port to decrease the brake application. When-

PRINCIPLES OF OPERATION (continued)

ever the pressure applied to the brake pedal is held constant for a moment, the valve returns to its "lap" or holding position, however, upon reaching the fully applied position, the valve plunger holds the valve poppet away from the vacuum valve seat to admit full manifold vacuum to the chamber at the right of the power cylinder piston. With the chamber to the left of the power piston open to atmospheric pressure, full power application attained is referred to as the "run-out" point of the power unit. Any increase in hydraulic pressure beyond this point would be supplied entirely by physical effort of the driver.

BENCH OVERHAUL

The following procedure applies when the complete Master-Vac (vacuum power section with linkage plus master cylinder) is removed as a unit from the vehicle.

DISASSEMBLY

1 Remove four hydraulic cylinder attaching nuts (7) and lockwashers (6) and lift off hydraulic cylinder (5). Remove seal ring (4) from groove in hub of hydraulic cylinder and remove hydraulic push-rod (3) from vacuum power section of Master-Vac. Note: Do not disturb adjustment screw. Keep rod with unit it is removed from.

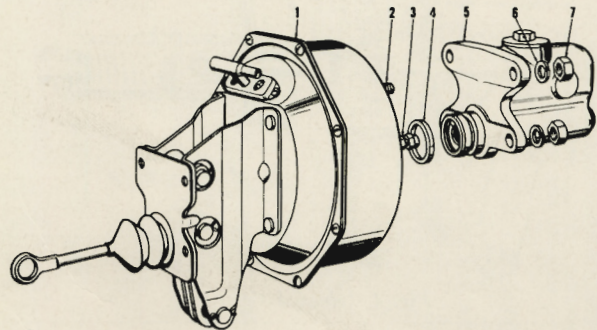
2 If Master-Vac includes power lever assembly in bracket, remove cotter pin (2) and clevis pin (3) from end of valve rod and power lever assembly and then remove rubber dust boot (1) from valve rod. Scribe across end plate and vacuum power cylinder. Remove eight end plate attaching screws (4) and separate end plate and bracket from vacuum cylinder. Disconnect hose (9) from vacuum tube on air cleaner (7). Remove air cleaner attaching screws (8), air cleaner (7) and air filter (6) from end plate. Scribe across vacuum piston and cylinder. Pull out vacuum piston (10) from cylinder and remove vacuum hose (9) from piston. Remove vacuum piston return spring (11).

3 Spring the felt retaining ring (1) sufficient to disengage ring from grooves in bosses of rear piston plate, then remove piston felt (2) and expand-er spring (3) from piston assembly (4).

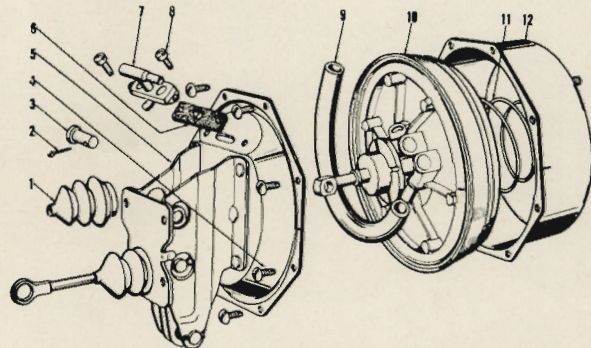
Maximum braking effort (or wheel slide) usually occurs below the point of "run-out" on most vehicles.

No Power Condition

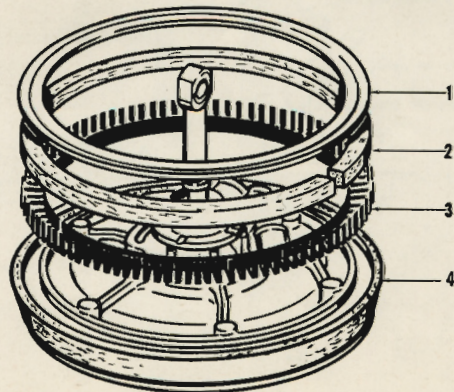
It should be noted that in the case of engine failure and consequent loss of engine vacuum, several power brake applications are possible by use of the vacuum in vacuum reservoir. In case of complete loss of vacuum, the brakes can be applied in the conventional manner, however, more effort is required due to the loss of power from the vacuum power section of the Master-Vac.



1 Removal of Hydraulic Cylinder

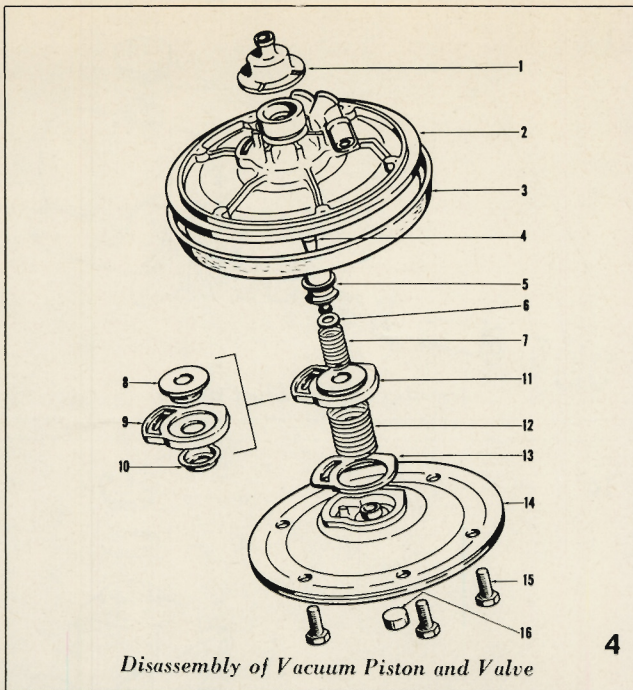


2 Removal of Air Cleaner End Plate and Bracket and Vacuum Piston

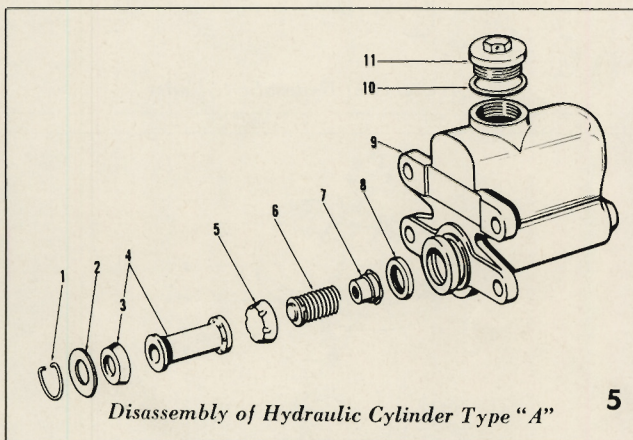


3

DISASSEMBLY

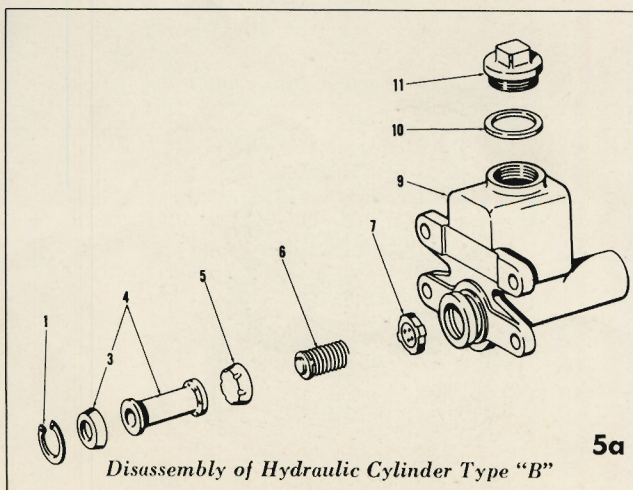


4 Remove seal and bumper (1) from end of push-rod and from rear piston plate (2); then remove six cap screws (15) from front piston plate (14). Lift off rear piston plate (2), leather piston packing (3) and remove push-rod with valve plunger from rear piston plate. Remove valve return spring (7), poppet and diaphragm assembly (11), poppet spring (12) and poppet support plate (13). Separate poppet spring retainer (10) and poppet diaphragm (9) from poppet (8). Remove rubber reaction disc (16) from front piston plate. If necessary, use a piece of rod having a smooth flat end to push reaction disc out of piston plate. Note: DO NOT separate valve operating rod (4) from valve plunger (5) unless replacement of valve rod or plunger is necessary. To replace either valve rod or valve plunger (5) hold assembly with valve plunger down and inject alcohol into cavity around valve rod to wet rubber lock in valve plunger; then drive or pry valve plunger off valve rod. Remove valve plunger bumper (6) (if used).



5 Two types of hydraulic cylinders are used, type "A" and type "B", see Figs. 5 and 5a. Remove snap ring (1) from groove in bore at end of master cylinder, then remove stop washer (2) (if used), piston assembly (4), primary cup (5), retainer and spring assembly (6), residual check valve (7) and check valve seat (8) (if used) from hydraulic cylinder (9). Remove filler cap (11) with gasket (10) (if used).

Note: DO NOT disassemble piston (4) unless secondary cup (3) is damaged or faulty. When necessary to remove secondary cup from piston use thin blade screw driver or scribe to stretch cup out of groove and over end of piston.



CLEANING

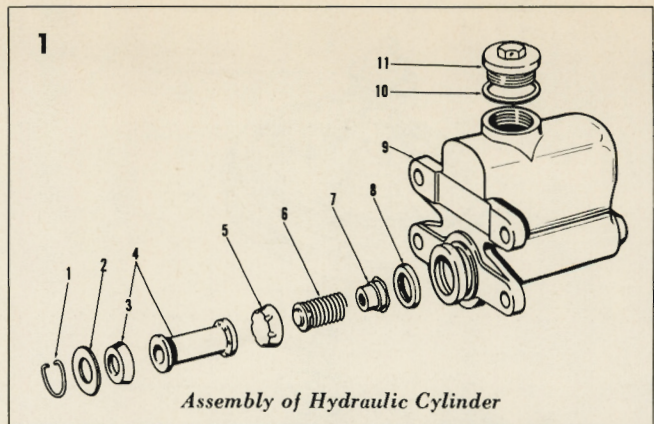
After disassembly, immersion of all metal parts in Bendix Metalclene or Speedclene is recommended. After parts have been thoroughly cleaned, those parts which come in contact with hydraulic brake fluid should be rewashed in *clean* alcohol before assembly. Use air hose to blow dirt and cleaning solvent from recesses and internal passages. When overhauling a Master-Vac, use all parts furnished in the Master-Vac Repair Kit. DISCARD ALL OLD RUBBER PARTS.

INSPECTION

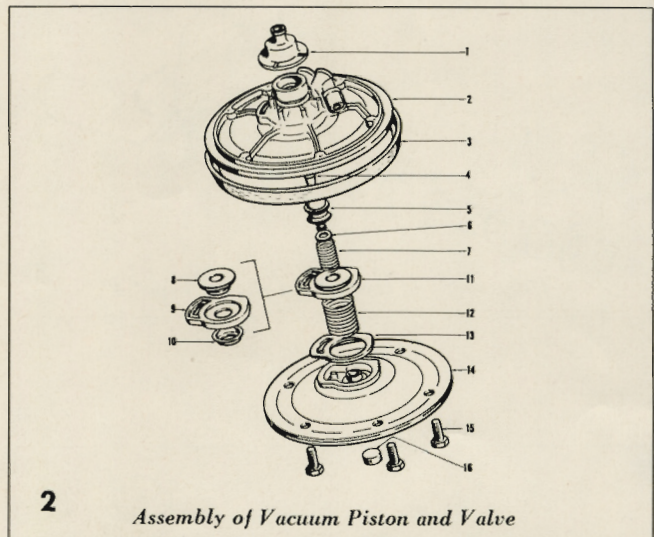
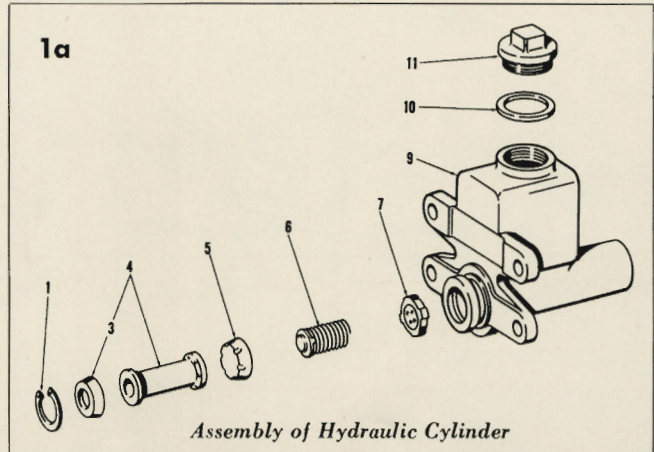
Inspect all other parts for damage or excessive wear. Replace damaged or excessively worn parts. If inside of vacuum cylinder is rusted or corroded, polish with steel wool or fine emery cloth. Replace cylinder shell when scored. Inspect hydraulic cylinder bore for signs of scoring, rust, pitting or etching. Any of these will require replacement of cylinder.

ASSEMBLY

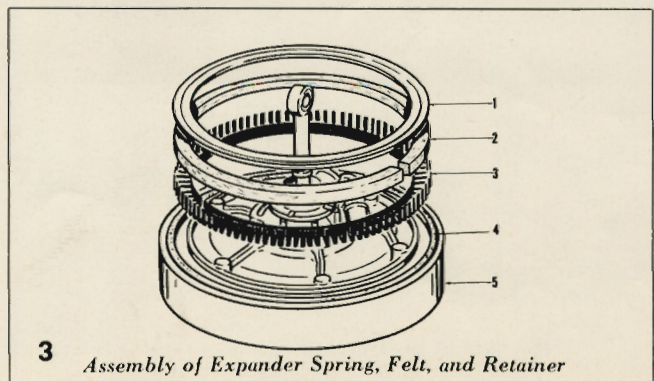
1 Coat bore of hydraulic cylinder (9) with brake fluid. If secondary cup (3) was removed from piston (4), dip cup in brake fluid and assemble cup over end of piston from end shown. Dip hydraulic cylinder parts (3) through (8) in brake fluid and assemble in bore of cylinder in order shown. Then assemble stop washer (2) and snap ring (1), making certain snap ring is seated in ring groove. Note: Stop washer (2) and residual check valve seat (8) are used *only* with hydraulic cylinder Fig. 1. Assemble new gasket (10) on filler cap (11) and replace filler cap. Gasket not used with plastic type filler cap.



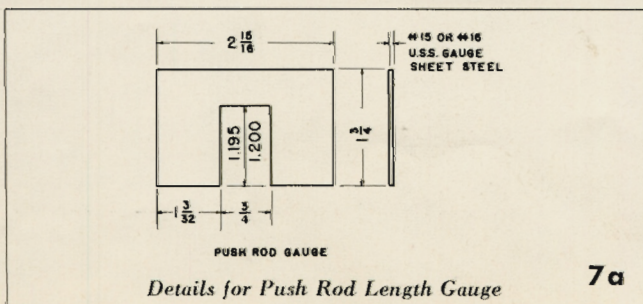
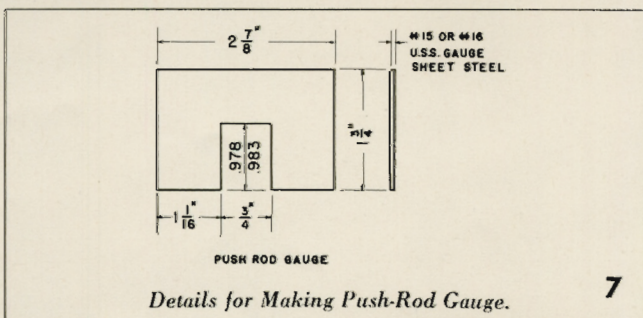
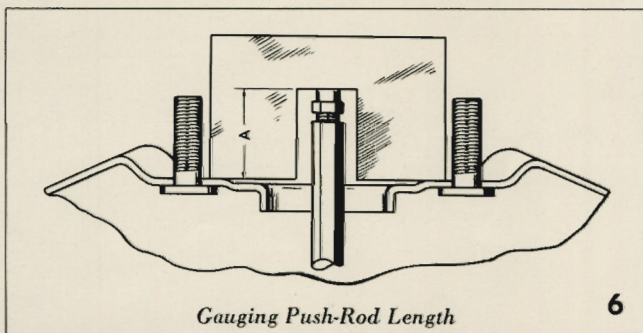
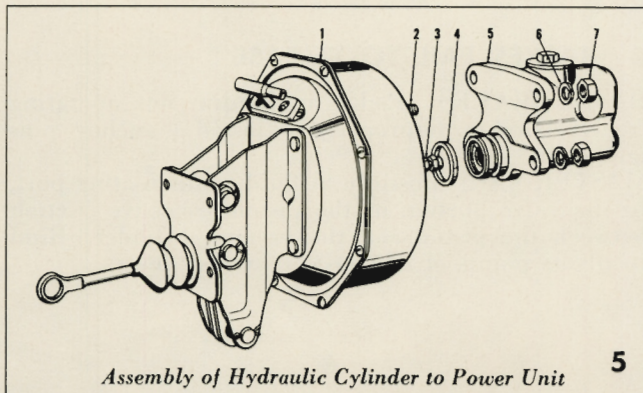
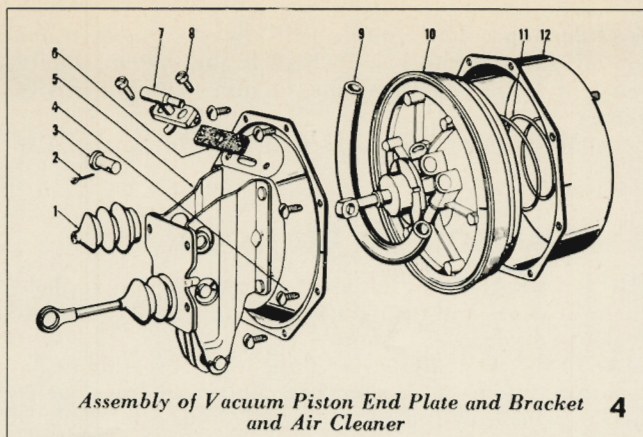
2 When servicing Master-Vac Part Nos. 378910, 379015, 379018 or 379418, assemble valve plunger bumper (6) over end of valve plunger (5). If valve operating rod (4) and valve plunger (5) were separated, dip valve plunger in alcohol and assemble to ball end of valve operating rod. Make certain ball end of rod is locked in place in valve plunger. It may be necessary to tap end of rod to lock rod in valve plunger. Apply light coating of Rykon "0" grease to front and rear bearing diameters of valve plunger and to both faces of reaction disc (16). Insert rod through hole in rear piston plate and assemble seal and bumper (1) over end of rod and over shoulder on piston plate (2). Assemble poppet diaphragm (9) over end of poppet (8). Make certain diaphragm is in recess of poppet. Press poppet spring retainer (10) over end of poppet and diaphragm. Clamp valve operating rod in vise with rear piston plate up. Lay leather piston packing (3) on rear plate with lip of leather over edge of plate. Install valve return spring (7) over end of valve plunger (5); then assemble poppet and diaphragm assembly (11) over valve return spring and align diaphragm with recess in rear piston plate. Place diaphragm support plate (13) in recess of diaphragm plate. Install poppet spring (12) over shoulder of retainer. Align and assemble front piston plate (14) to rear piston plate. Center poppet spring on front piston plate and center valve plunger stem in hole of piston. Hold plates together and install six piston plate cap screws (15). Leave screws loose. Insert rubber reaction disc (16) in center bore of front piston plate. Caution: Use care not to lose reaction disc out of piston before push-rod is installed.



3 Place assembly ring (5) (Part No. 73665) over piston packing, turn piston assembly (4) upside down and assemble expander spring (3) against inside lip of leather packing as shown. Saturate felt (2) in Bendix Vacuum Cylinder Oil and assemble in expander spring. Assemble retainer ring (1) over bosses on rear piston plate making certain retainer is anchored in all six grooves of piston plate. Securely tighten six cap screws in front piston plate.



ASSEMBLY



4 Attach vacuum hose (9) to tube on vacuum piston (10), and align so hose lays flat against piston. Apply thin coat of vacuum cylinder oil to bore of vacuum cylinder. Remove assembly ring from vacuum piston. Assemble air cleaner filter (6) over vacuum tube of air cleaner and tube assembly (7) and attach air cleaner to end plate and bracket in position shown with screws (8). Install end plate and bracket over valve operating rod and attach vacuum hose (9) to tube attached to end plate. Note: Before proceeding further, make certain reaction disc is in place in front piston plate. Center small diameter end of piston return spring (11) in vacuum cylinder (12). Center vacuum piston on spring and cylinder and end plate to scribe marks. Compress spring and attach end plate to cylinder with eight cap screws (4). Tighten screws uniformly. Dip rubber dust guard (1) in alcohol and assemble over end of valve rod and over flange of end plate. Note: On units which include power lever assembly, apply a light coating of Rykon "0" grease to bearing points of linkage and then attach valve rod to levers using clevis pin (3) and cotter pin (2). If dust guard was removed from pedal rod, dip guard in alcohol and assemble over pedal rod and attach to end plate bracket.

5 Apply a light coating of Rykon "0" Grease to the piston end of the hydraulic push-rod (3) and guide piston end of push-rod into center bore of front piston plate. Twist push-rod to make certain piston end is bottomed against reaction disc and there is no air pocket between push-rod and reaction disc. NOTE: Before proceeding, check the distance "A" from the end of the push-rod to the hydraulic cylinder mounting surface at the end of the vacuum cylinder. This dimension "A" Fig. 6 should be as follows:

Dimension "A"	Master-Vac Pt. No.	Ident. Mark
.983 - .978	for 379110	M
1.200 - 1.195	for 378900	CA
1.200 - 1.195	for 378910	C
1.200 - 1.195	for 379039	P

If push-rod dimension is not correct see push-rod adjustment procedure below. When push-rod length is correct, replace rubber seal ring (4) in groove on hub of hydraulic cylinder (5) and assemble hydraulic cylinder to vacuum cylinder (1) with four lockwashers (6) and nuts (7). Securely tighten nuts.

6 PUSH-ROD ADJUSTMENT

The self-locking adjustment screw is set to the correct dimension at the time of original assembly of the power unit. Under normal service no further adjustment should be needed providing the push-rod assembly remains in the original Master-Vac. If, however, the push-rod is transferred to another Master-Vac or a new push-rod is used, adjustment will be necessary.

To adjust push-rod hold push-rod and turn adjusting screw either in or out of push-rod to the specified dimension using either a micrometer gauge or a height gauge. Figures 7 and 7A gives details for making either or both height gauges.

ASSEMBLY IS NOW COMPLETED.

TROUBLE SHOOTING

Brake troubles may be easily diagnosed if the complaint is understood. The trouble will always appear in one or more of the four common complaints covered below. Related parts of the basic wheel brake system should be checked and corrections made in adjustments, lubrication and lining specifications, or other components in accordance with the vehicle manufacturer's recommendations.

The following briefly cover the conditions that apply to the Master-Vac and corrections should be made in accordance with procedures covered in this manual.

1 HARD PEDAL

BASIC BRAKES: The pedal mechanism should be thoroughly checked for free movement of all parts and lubricated per vehicle manufacturer's specification. Glazed linings or linings saturated with fluid should be replaced.

MASTER-VAC: Check for vacuum leaks in system, collapsed or restricted vacuum hose or line, and also for low manifold vacuum. Possible restricted air cleaner or internal vacuum leak.

2 "GRABBY" BRAKES

BASIC BRAKES: Can be caused by grease or brake fluid on lining, brake shoe anchor pins positioned incorrectly or scored drums.

MASTER-VAC: Possibly in control valve portion of piston or at reaction rod.

3 PEDAL GOES TO THE FLOOR

BASIC BRAKES: Require adjustment or replacement of shoes and lining. Check for cracked drum and leaks in hydraulic system.

MASTER-VAC: Reservoir fluid level low—air in hydraulic system of Master-Vac, in brake lines, or in brake wheel cylinders. Internal hydraulic leak at primary piston cup.

4 BRAKES FAIL TO RELEASE

BASIC BRAKES: Pedal mechanism not operating freely—brakes improperly adjusted—anchor pins bound up.

MASTER-VAC: Possibly at fluid compensating port, in the valve portion of the piston, excessive friction between the piston and the vacuum cylinder. Bind in pivots points of Master-Vac bracket levers.